Intellectual Property Office of New Zealand
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CERTIFICATE

This certificate is issued in support of an application for Patent registration in a country outside New Zealand pursuant to the Patents Act 1953 and the Regulations thereunder.

I hereby certify that annexed is a true copy of the Provisional Specification as filed on 10 April 2002 with an application for Letters Patent number 518288 made by FISHER & PAYKEL APPLIANCES LIMITED.

Dated 24 April 2003.

Neville Harris
Commissioner of Patents

NEW ZEALAND

PATENTS ACT, 1953

PROVISIONAL SPECIFICATION

Washing Appliance Water Softener

We, **FISHER & PAYKEL APPLIANCES LIMITED**, a company duly incorporated under the laws of New Zealand of 78 Springs Road, Auckland, New Zealand, do hereby declare this invention to be described in the following statement:

FIELD OF INVENTION

The present invention relates to an automatic washing machine and in particular but not solely to a dishwasher, provided with a water supply circuit including a water softener and associated arrangement to periodically regenerate the water softener.

SUMMARY OF PRIOR ART

It is well known that soft water is more effective than hard water in washing clothes, dishes or other articles. To solve the problem of hard water, small water softeners associated with either a washing machine or dishwasher have been used to soften the water entering the machine.

In water softeners a decalcifier which may comprise a resin container exchanges both the calcium ions (Ca^{2+}) and magnesium ions (Mg^{2+}) contained in the water with sodium ions (Na^{+}) contained in appropriate resins placed in the resin container. The resins are tiny beads, generally of an inert polymer structure.

Resins or other similar substances become exhausted after a certain usage time. Their ions Na^{+} to be exchanged with Ca^{2+} and Mg^{2+} contained in the water are consumed; as a result, water will still flow through the resin container but the hardness of the water is not reduced. This drawback is prevented through a resin regeneration cycle. A brine solution (NaCl) is introduced with the aim of regenerating the resin.

To adjust for different levels of water hardness EP219704 Milocco et al and EP433676 Bongini describe means for adjusting the mean path flow of the water through the resin container to adjust the level of water softening. Such arrangements are not easy to use and difficult to manufacture.

A difficulty as to when to replenish salt is addressed by EP0351564 Jerg et al using a mechanical float to indicate the presence or absence of salt. Mechanical float devices can stick and can give a wrong indication resulting in the presence of salt being indicated when there is a lack of salt and the water entering the washing appliance is consequently not soft enough.

Water softeners aim to keep the softness of water within desired bounds, in order to achieve this desire the resins in the resin container need to be kept charged with sodium ions (Na^{+}). EP900765 Zucholl uses electrical conductivity sensors to detect the need to regenerate the resins. EP919178 Carli and EP1048776 Carli also use sensors to detect the degree of exhaustion of the resins. Such sensors include the physical volume of the resins, the pressure exerted by the resins on a switch and the movement of an element contained

within the resin container. Such devices add complexity to manufacturing water softeners.

Controlling the volume of brine flushed through the resin container can also control the water softness. EP0367062 Fontana; EP545127 Milocco and EP0860140 Carli use water chambers to regulate the amount of brine flushed through the resins. The use of multiple water chambers adds to the difficulty of manufacturing such water softeners and adjusting such devices.

SUMMARY OF INVENTION

It is an object of the present invention to provide a water softener for an appliance which at least goes some way towards overcoming the above disadvantages or at least provides the public with a useful choice.

In a first aspect the invention may broadly be said to consist of a washing appliance which in use is connected to a water supply, said appliance including a water softener and a programmed controller, said water softener comprising:

a resin container for softening water which receives water from said water supply and supplies water to said washing appliance;

a brine container having an inlet for the supply of salt, an inlet for the supply of water and an outlet;

a pump controlled by said programmed controller which receives water from said outlet of said brine container and supplies said resin container, said pump energised by said programmed controller to pump brine from said brine container through said resin container to thereby regenerate said resins, with a pumping cycle alterable in accordance with the water hardness.

Preferably said water softener additionally comprises a two-way valve connected between said water supply and said resin container energised by said controller to either direct water directly to said washing appliance or direct to said resin container.

Preferably said controller can achieve a desired water softness supplied to said washing appliance by switching said two-way valve so as to determine the ratio of water directly supplied to said washing appliance and water supplied from said resin container.

Preferably said water softener is in a wall of said washing appliance.

Preferably said water softener supplies water directly to a detergent dispenser mounted in a wall of said appliance.

Preferably said brine container additionally has an overflow weir for the maintenance of a maximum water level in said bine container.

Alternatively supply of water to said brine container is controlled by a float valve.

Preferably said brine container has a salt absence indicator, said absence indicator comprising:

a light source and light sensor located in spaced apart relationship at the bottom of said brine container, to define an optical part there between a controller receiving as an input the output signal of said light sensor, and

an indicator light said indicator light being energised by said controller upon receiving a signal from said light sensor when the optical path between the light source and light sensor is substantially transmissive.

Alternatively said salt absence indicator comprises:

a light pipe extending between said brine container and a point of visibility,

a light located in the bottom of said brine container in alignment with the bottom of said light pipe,

rays from said light passing through said light pipe when solid salt is absent from the space between the light and the end of the light pipe.

Preferably said overflow weir spillage is coupled directly to an appliance drain.

Alternatively said overflow weir spillage is coupled directly to an appliance sump.

Preferably said appliance in use being accommodated within a cavity in kitchen joinery or a free-standing cabinet, additionally comprises:

a wash system slidably mounted within said cavity in a manner that it may be withdrawn horizontally for access thereto, said wash system including:

an open top chamber adapted to accommodate items to be washed and within which water is circulated;

means for evacuating wash liquid from said chamber; and

a wash chamber closure that covers the open top of said open top chamber on retraction of wash chamber into said cavity.

Preferably said washing appliance is a dishwasher.

In a second aspect the invention may broadly be said to consist of water softener comprising:

a resin container for softening water which receives water from a water supply;

a brine container having an inlet for the supply of salt, an inlet for the supply of water and an outlet;

a pump controlled by a programmed controller which receives water from said

outlet of said brine container and supplies said resin container, said pump energised by said programmed controller to pump brine from said brine container through said resin container to thereby regenerate said resins with a pumping duty cycle alterable in accordance with the water hardness.

Preferably said water softener additionally comprises a two-way valve, in one position water does not pass through said resin container in second position water is softened.

Preferably said two way valve is switchable by said programmed controller.

Preferably said programmed controller can achieve a desired water softness of water leaving water softener by switching said two-way valve.

Preferably said brine container additionally has an overflow weir for the maintenance of a maximum water level in said brine container.

Preferably said supply of water to said brine container is controlled by a float valve.

Preferably said brine container has a salt absence indicator, said absence indicator comprising:

a light source and light sensor located in spaced apart relationship at the bottom of said brine container, to define an optical part there between a controller receiving as an input the output signal of said light sensor, and

an indicator light said indicator light being energised by said controller upon receiving a signal from said light sensor when the optical path between the light source and light sensor is substantially transmissive.

Alternatively said salt absence indicator comprises:

a light pipe extending between said brine container and a point of visibility,

a light located in the bottom of said brine container in alignment with the bottom of said light pipe,

rays from said light passing through said light pipe when solid salt is absent from the space between the light and the end of the light pipe.

Preferably said brine container has an indicator to indicate the absence of solid salt.

Preferably said indicator comprising an indicator light energised when the absence of solid salt has been detected using a light and light sensor located in the bottom of said brine container.

Preferably energising of said indicator light is controlled by said programmed controller.

Preferably programmed controller can delay energising said indicator light for a delay period after absence of solid salt is detected.

Alternatively said indicator comprises a light and a light pipe.

In a third aspect the invention may broadly be said to consist in a washing appliance which in use is connected to a water supply said appliance in use being accommodated within a cavity in kitchen joinery or in a free-standing cabinet, said appliance comprising:

a wash system slidably mounted within said cavity in a manner that it may be withdrawn horizontally for access thereto, said wash system including:

an open top chamber adapted to accommodate items to be washed and within which water is circulated;

a water softener means associated with said open top chamber;

means to supply water to said water softener means;

means for evacuating wash liquid from said chamber; and

a wash chamber closure that covers the open top of said open top chamber on retraction of wash chamber into said cavity.

Preferably said water softener means is in a wall of said washing appliance.

Preferably said water softener means supplies water directly to a detergent dispenser mounted in a wall of said appliance.

Preferably said washing appliance is a dishwasher.

In a fourth aspect the invention may broadly be said to consist in a salt absence indicator for a brine container of a water softener, said salt absence indicator comprising:

a light source and light sensor located in spaced apart relationship at the bottom of said brine container, to define an optical part there between a controller receiving as an input the output signal of said light sensor, and

an indicator light said indicator light being energised by said controller upon receiving a signal from said light sensor when the optical path between the light source and light sensor is substantially transmissive.

Preferably said controller includes means for delaying energising said indicator light for period after receiving said signal from said light sensor corresponding to said optical path being transmissive.

In a fifth aspect the invention may broadly be said to consist in a salt absence detection indicator for a brine container of a water softener, said indicator comprising:

a light pipe extending between said brine container and a point of visibility,

a light located in the bottom of said brine container in alignment with the bottom of said light pipe,

rays from said light passing through said light pipe when solid salt is absent from the space between the light and the end of the light pipe.

This invention may also be said broadly to consist in the parts, elements and features referred to or indicated in the specification of the application, individually or collectively, and any or all combinations of any two or more of said parts, elements or features, and where specific integers are mentioned herein which have known equivalents in the art to which this invention relates, such known equivalents are deemed to be incorporated herein as if individually set forth.

BRIEF DESCRIPTION OF DRAWINGS

Preferred embodiments of the invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a diagrammatic longitudinal cross-section of a dishwasher of the preferred type to which the present invention relates,

Figures 2 and 3 show in diagrammatic form the plumbing and wiring system employed in the dishwasher shown in Figure 1.

Figure 4 is a schematic diagrammatically illustrating a first embodiment of the water softener of the present invention

Figure 5 is a schematic diagrammatically illustrating a second embodiment of the water softener of the present invention with a float valve to control water level in brine tank.

Figure 6 is a schematic diagrammatically illustrating a third embodiment of the water softener of the present invention using an alternative float valve to control the water level in the brine tank.

Figure 7 shows the light and light pipe for indicating the need to replenish salt.

Figure 8 shows the salt detector of the preferred water softener of the present invention.

Figure 9 shows the salt replenishment device of the preferred water softener of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention is a water softener particularly for use in a dishwasher. The water softener is located in the dishwasher water supply between the primary supply valve and the dishwasher chamber. The softener includes a resin container 207 with an ion

exchange resin. Water supplied to the dishwasher chamber optionally passes through the resin container 207. Regenerating brine is developed in a brine container 203. The brine container 203 is supplied manually with solid salt and water diverted from the main supply at an air break 201. In the regenerating cycle brine is delivered from the brine container 203 to the resin container 207 by a pump 206. The operating cycle of pump 206 determines the degree of regeneration of the resin.

The present invention is particularly adapted for use in a dishwasher of a type illustrated in Figure 1. A wash chamber 101 with all wash components fitted and a front panel 102 are slidably mounted within a cavity 103. The wash chamber 101 has an open top 104 and is drawn from the cavity 103 in the direction of arrow 105 to allow loading and unloading of dishes and is retracted into the cavity 103 during washing. The wash and drain systems are fitted within wash chamber 101, including a motor, pumps and water supply circuit. Flexible connecting wiring and plumbing 107 couple the wash chamber 101 to the relevant terminations within the cavity 103 this can be best seen in Figures 2 and 3. A lid 106 seals the chamber during washing of dishes. The water softener is located in a wall 108 of the dishwasher.

The operation of the dishwashing machine is controlled by a programmed controller of a known type.

Referring to Figure 4 the washing machine water supply includes a water softener according to the present invention, with the diverter valve and pump operable at the control of the program controller.

In the normal washing cycle water enters from a main flow control valve through inlet 238 and supply conduit 214. The supply conduit 214 leads to an air break 201. An air break 201 is commonly provided to prevent back flow. The flow passes through the air break 201 to a diverter valve 211. The diverter valve 211 is controlled by the appliance controller and controls whether or not the water entering the wash chamber 101 is softened or bypasses the resin container 207 and therefore is not softened before entering the wash chamber 101.

When the water is to be softened the diverter valve 211 is in position 225 and water flows via conduit 216 through the diverter valve 211 via conduit 217 to resin container 207. The water is softened by the resins in the resin container 207 and enters the dish wash chamber 101 via conduit 219 and outlet 218. When water is not to be softened the diverter valve 211 is in position 226 and the water flows to the wash chamber 107 via

conduit 219 and outlet 218. Water flowing to the wash chamber may pass through a detergent dispenser (not shown).

The programmed controller may also switch the diverter valve 211 during water supply to change the softness level of water supplied to dishwasher. The diverter valve may be switched to mix unsoftened water and softened water to achieve the desired softness level of water supplied to the dishwasher. Some cycles in the washing program do not require soft water for example the initial rinse and the controller can switch the diverter valve to achieve a desired water softness for each cycle.

To supply water to the brine container 203 an air break 201 in the water supply circuit has an outlet orifice 202 bleeding off a proportion of water passing there through. The leakage through orifice 202 flows via conduit 222 into the brine container 203. Water is supplied to the brine container 203 using this leakage from outlet 202. This has the advantage of the elimination of active parts to supply water to the brine container 203. Any excess fluid in the brine container 203 overflows weirs 204 and 230 and enters the wash chamber 101 via a air breather 231, or flows by a concealed conduit (now shown) to the dishwasher drain or sump. Excess leakage from the air break 201 is also channelled away via air breather 231 or flows by a concealed conduit (not shown) to the dishwasher drain or sump.

Alternatively as seen in Figure 6 a float valve 250 controls the fluid level in the brine container 203. Water supplied by conduit 222 is prevented from entering the brine container 203 by float valve 250 when water is at or above level 232. Excess leakage from the air break 201 is channelled away via air break 230 or flow by concealed conduit (not shown) to the dishwasher drain or sump.

In a further alternative as seen in Figure 5 water flows through the air break 203 via conduit 251 into the brine container 203. A float valve 250 prevents water flowing into the brine container 203 when the fluid level of the resin container is at or above level 232.

A salt filling orifice 208 is used to manually replenish the salt in the brine container 203. The salt filling orifice 208 is plugged with a cap or bung 224 when not opened for refilling. The fluid in the brine container 203 is at a level 232 below the filling orifice 208.

A suitable device shown in Figure 9 is used to replenish the salt. The device is shaped so that the salt granules flow freely into the brine container 203. The shape is also

necessary because the salt filling orifice 208 of the brine container 203 is in a vertical wall of an appliance.

As the brine container 203 is filled with salt, the level of water in the brine container is maintained by having the excess fluid overflow the weirs 205 and 230. This has the advantage that the container used to refill the salt does not get wet nor is salt washed away and wasted. Any fluid overflowing the weirs 204 and 230 comes from the top of the brine container 203, and will have a lower content of dissolved salt.

Alternatively as seen in Figures 5 and 6 the fluid level in the salt container rises when salt is added but because of the use of the float valve 250 no fluid is added until the level is below the float valve level. Because the fluid level 232 is below the salt level 270 when salt is added the fluid level will rise but not sufficiently to overflow.

Air vents 234, 235 allow for the removal of air by conduit 236.

The presence of solid salt in the brine container 203 is sensed using a salt sensor 209. The salt sensor includes a light 212 and light sensor such as a photo transistor 213 positioned at the bottom of the brine container 203. The sensor can be seen in Figure 8. The presence of solid salt can be detected because solid salt deflects light reducing the intensity of light received at light sensor 213 from light 212, to an extent that the presence of solid salt can be differentiated from the absence of solid salt. The light sensor 213 output signal is supplied to an analogue input part of controller.

A salt empty indicator 210 provides a salt empty indication to a user. A light emitting diode can be used as the indicator. It is energised by the programmed controller. Timing when the salt empty indicator 210 is switched on can be altered relative to when the salt sensor 209 first detects an absence of solid salt. This delay can take into account the presence of dissolved salt in the brine container 203. Alternatively the salt empty indicator can be switched on directly by a salt sensor control circuit.

The salt indicator 210 is in the bung 224 of the brine container 203. In the preferred embodiments seen in Figure 7 a light 290 shining in direction of arrows 291 shines through light pipe 292 and as seen by a user as indicator 210.

In a further alternative seen in Figures 5 and 6 the salt sensor is replaced with an light 260 and a light pipe 262 the light shining through the light pipe only when solid salt is absent. When solid salt is present light is deflected and does not shine through the light pipe. A gap 261 between light 260 and light pipe 262 when solid salt is present deflects the light.

An outlet 205 in the brine container 203 feeds brine to a pump 206 via a conduit 221. The brine flowing out of the brine container 203 is pumped through a resin container 207 replenishing the resins which are used to reduce the hardness of the water. A mesh 240 prevents solid salt from being pumped through the resin container 207. Excess fluid pumped through the resin container 207 is drained away via conduit 219 and outlet 219 to the dishwasher drains. The pump 206 is directly controlled by the programmable controller and the quantity of fluid delivered to the resin bed is controlled by controlling the pumping cycle of the pump. The pumping cycle can be adjusted via a keypad attached to the controller.

The amount of brine that is pumped through the resins affects the overall replenishment of the resins. How replenished the resins are, affects the ability of the resins to soften the water. The more replenished the resins are the greater the difference between the water entering the resin container via conduit 217 and the water leaving the resin bed via conduit 219 and outlet 218 will be. A desired water softness level can be achieved by adjusting the amount of brine replenishing the resins and this can be adjusted by altering the cycle of the brine pump 206.

In a resin replenishment cycle the diverter valve 211 is in position 226 and the brine is pumped by the brine pump 206 from the brine container 203 into resin container 207. Water leaving the resin container 207 as the brine is pumped in will pass through conduit 219 and outlet 219 into the dishwasher chamber 101 and be drained away.

In an alternative embodiment the two way valve 211 would be in position 225 and a - percentage of water leaving the resin container 207 would pass via conduit 215 leakage 202 and conduit 222 into the salt container 203. A percentage would still pass into the dishwasher chamber 101 and be drained away. This has the advantage of reducing water usage.

Using the brine pump the regeneration of the resins in the resin container could happen even when the resin container is softening water for supply to the dishwasher chamber.

DATED THIS 10 DAY OF Apr 2002

AJ PARK
PER
AGENTS FOR THE APPLICANT

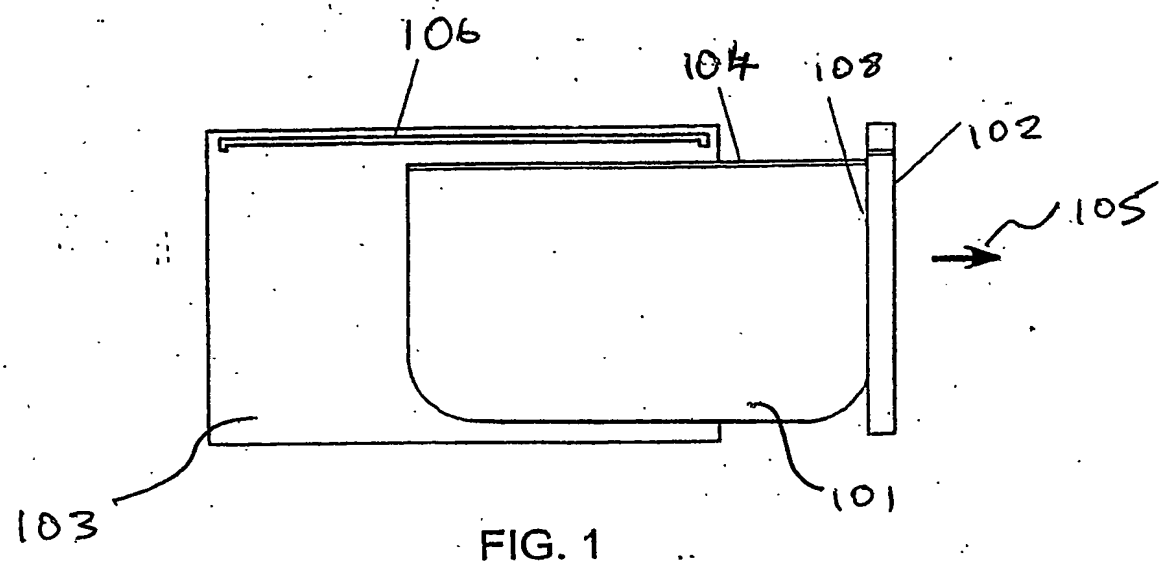
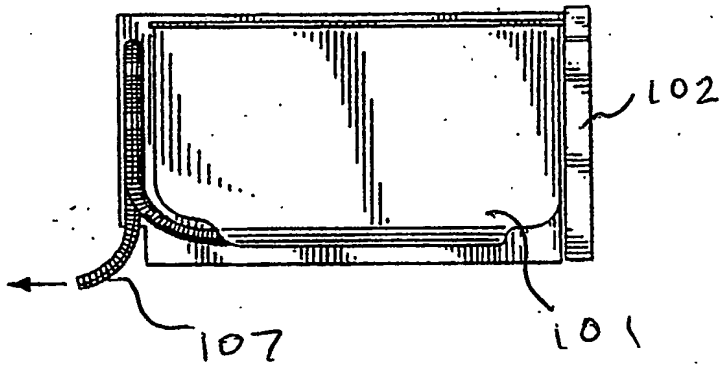


FIG. 1

FIG. 2



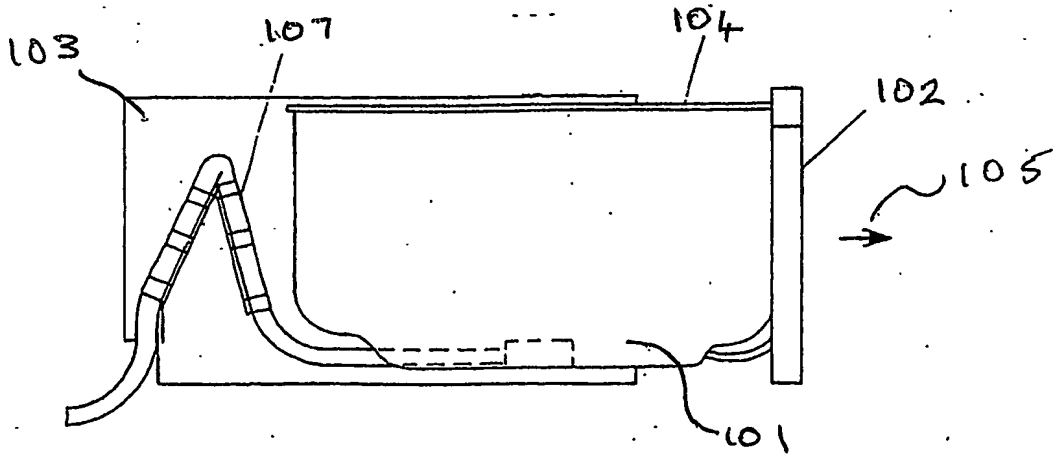


FIG. 3

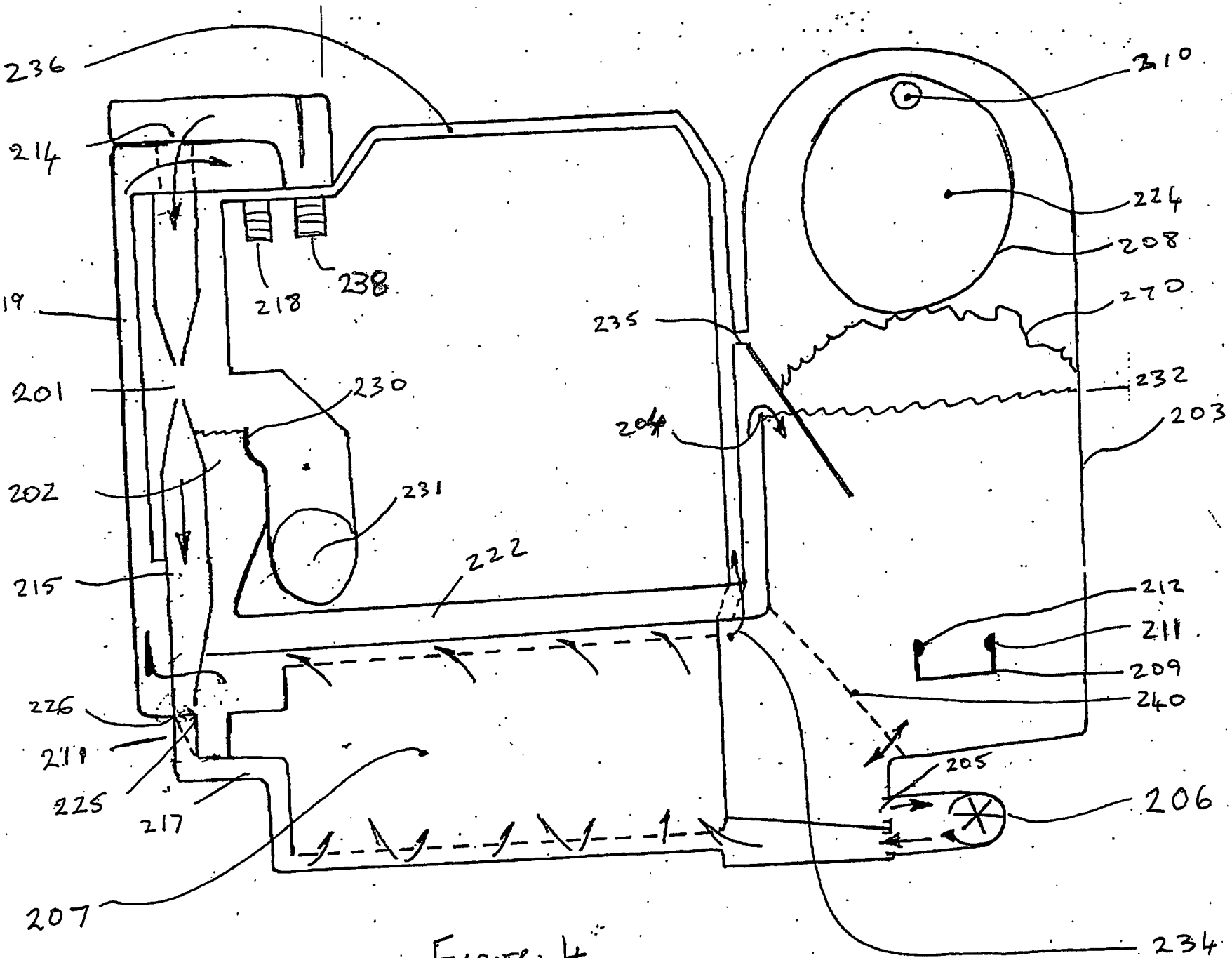

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Figure 4

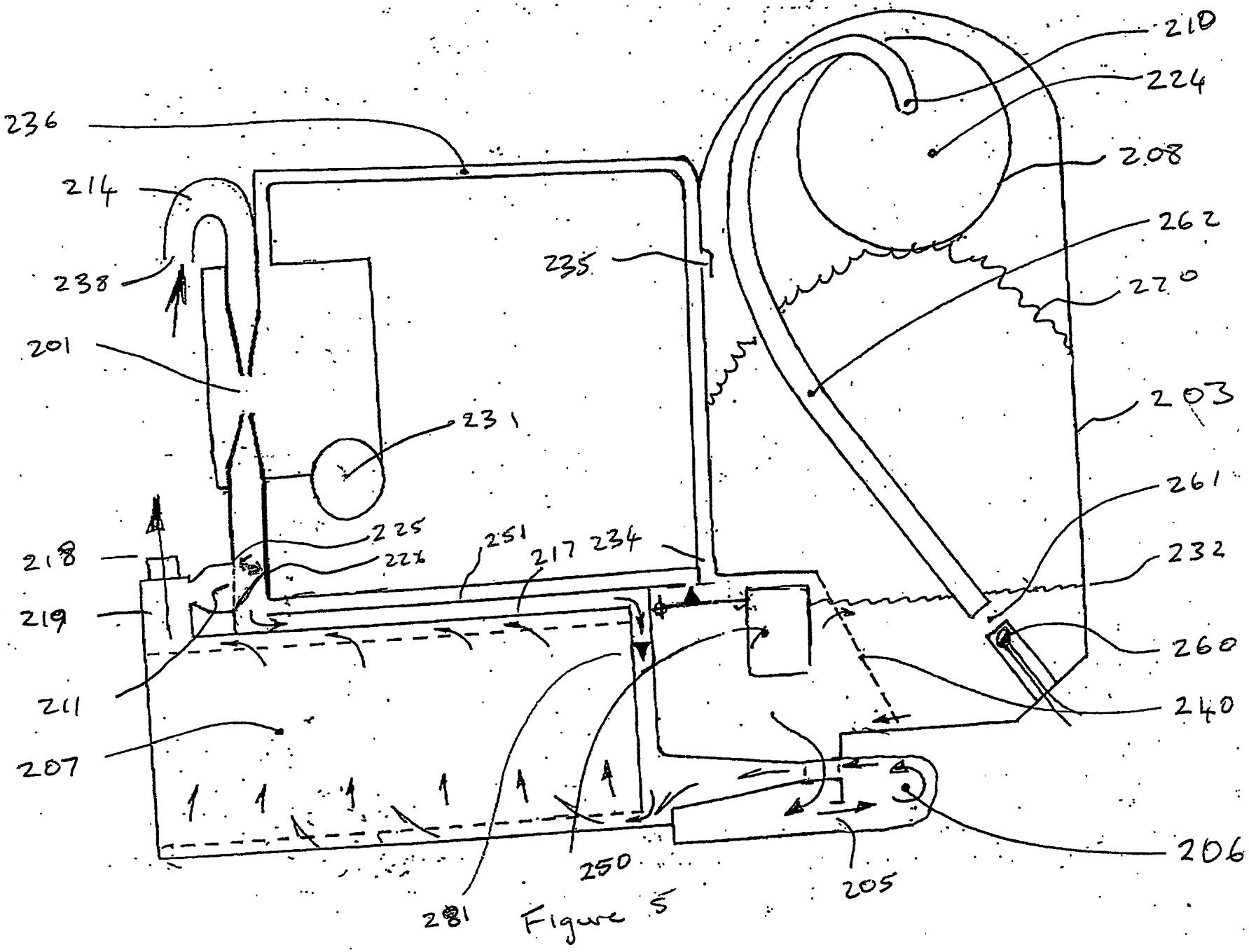
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Figure 5

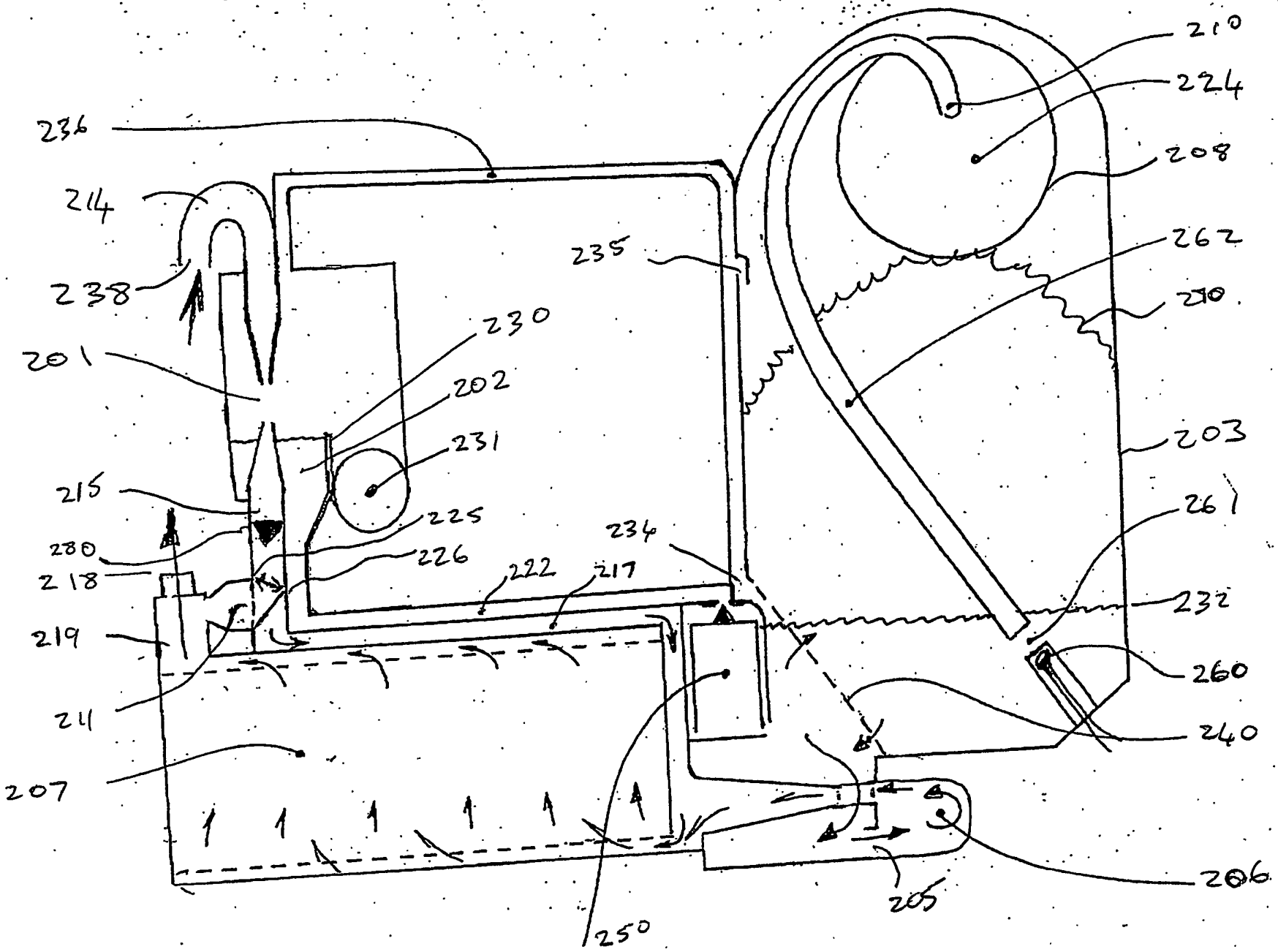
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Figure 6

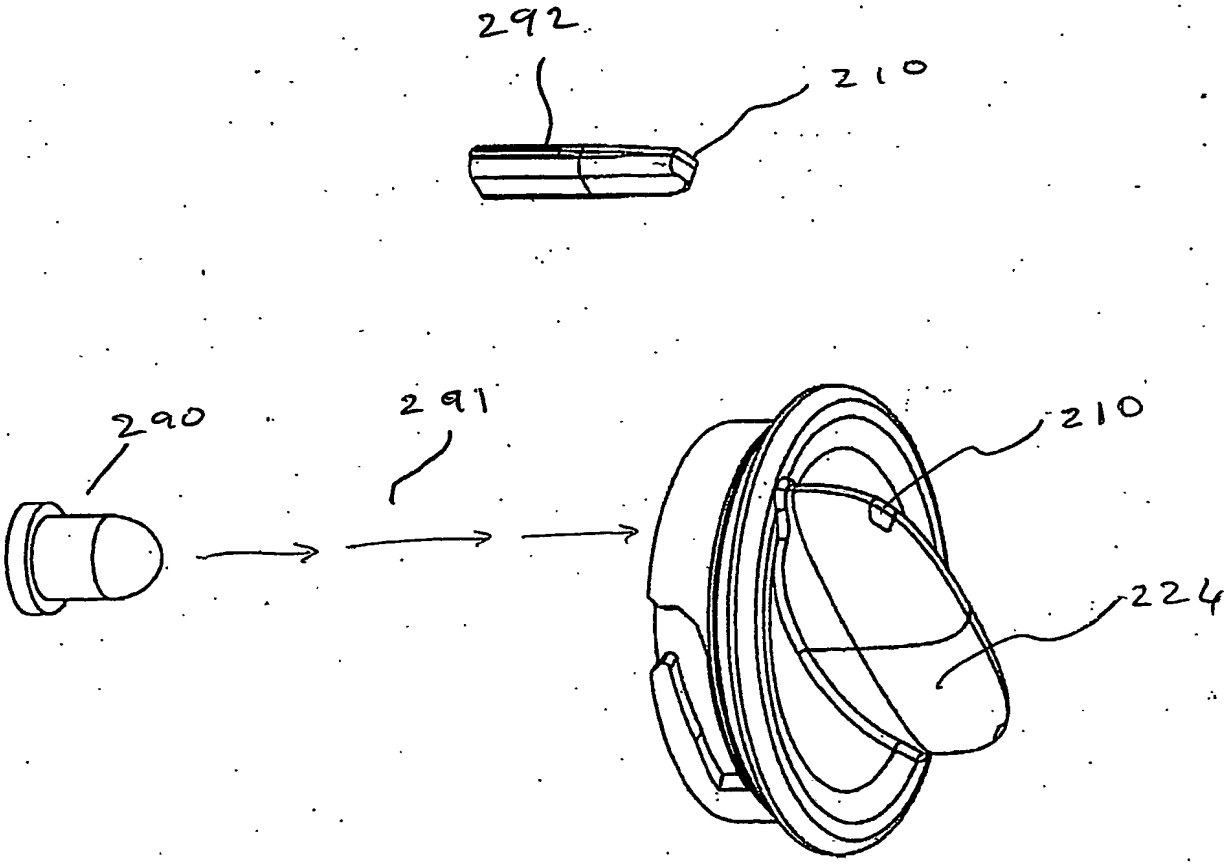

Figure 7

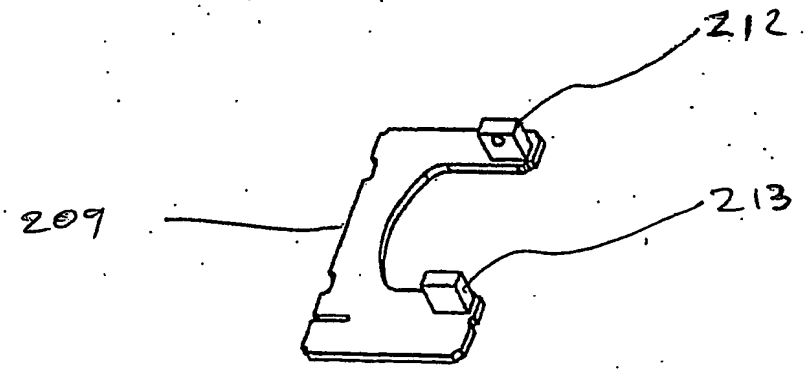

Figure 8

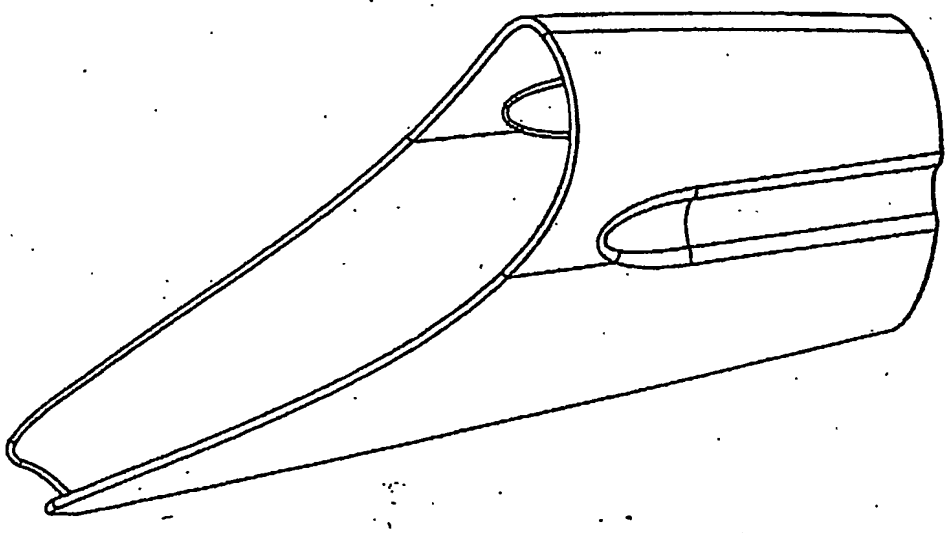

Figure 9